

STEM intervention programs: funding practices and challenges

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This study examines the funding practices and challenges of diversity initiatives found in the science, technology, engineering, and mathematics (STEM) fields. Interviews with 55 intervention program administrators, representing 48 unique STEM intervention programs, were conducted at nine large research-intensive universities. The interviews, which examined the design, structure, implementation, and funding challenges of STEM interventions, revealed that institutional funding priorities often run counter to national efforts to increase diversity within STEM. As institutions face budget cuts and reduced external funding, institutional support of STEM interventions reflects the university's commitment (or lack thereof) to diversifying the STEM fields. Many programs struggled with changes in funding over time, inadequate staffing and service delivery, and long-term program sustainability.

Keywords: funding; interventions; legitimacy; STEM

Introduction

The need to maintain scientific innovation, economic prosperity, and global leadership has resulted in calls to increase postsecondary participation for domestic students in the United States, especially in science, technology, engineering, and mathematics (STEM) fields. Obtaining a postsecondary education has never been more important, both for economic benefits and social mobility. Job projections indicate that over 60% of jobs within STEM will require a minimum of a bachelor's degree by 2018 (Carnevale, Smith, and Melton 2011). Access to higher education, however, has not been equally distributed among traditionally underrepresented communities. Minority students comprise the majority of today's college-age population, yet are grossly underrepresented within higher education, especially within STEM (Millett and Nettles 2006; Taningco, Mathew, and Pachon 2008).

Despite earning half of all science and engineering (S&E) bachelor's degrees, women's share of degrees remain concentrated within chemistry, biology, agriculture and the social sciences (National Science Board 2012). From 2000 to 2009, women experienced a 13–34% decline in their share of computer science, electrical, industrial, and chemical engineering degrees. The growth in S&E degree attainment for racial and ethnic minorities suggests modest improvements in the last decade, reflecting an increase in S&E degree attainment by 2% among Latino students, a 1% increase among black students, and 0.2% increase among American Indian/Alaskan Natives.

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Together, these minority groups conferred less than 17% of S&E degrees. Given the importance of postsecondary education as a function of both social mobility and economic productivity, access to a college degree, especially within high-need, high-earning fields such as STEM (Carnevale and Cheah 2013), is of national concern.

The level of underrepresentation of domestic women, racial minorities, first-generation, and low-income students in STEM represents the nation's failure to develop human capital (Chapa and De La Rosa 2006; Smyth and McArdle 2004). Concerns of equity, diversity, inclusion, scientific advancement, and workforce preparedness in STEM have been expressed by the Committee on Equal Opportunities in Science and Engineering (2004) and the Committee on Underrepresented Groups and the Expansion of the Science and Engineering Workforce Pipeline (2011). Others have emphasized the importance of building students' STEM competencies to fulfill the nation's economic and workforce needs (Carnevale, Smith, and Melton 2011). These reports call on US colleges and universities to increase the total number of STEM graduates and the number of degrees awarded to underrepresented populations.

The current recession presents a number of challenges to institutions of higher education. State budget shortfalls have forced some public research universities to consider and/or implement tuition increases, furloughs, and hiring freezes. A comparison of 2008 and 2013 state-level budgets shows that 48 states reduced funding for higher education, with 36 states reducing funding by more than 20% (Oliff et al. 2013). As universities become more tuition-dependent, access to higher education becomes increasingly limited for lower-income students who depend on financial aid to attend college.

Underrepresented students entering STEM may face additional hurdles. Inadequate academic preparation and unwelcoming campus climates are well-documented barriers in the literature (Museus et al. 2011), all of which contribute to the 'leaky pipeline' (Blickenstaff 2005). Less frequently examined topics include institutional factors, such as SIPs and their funding sources, which are the focus of the current study. During uncertain economic times many public colleges and universities make difficult decisions regarding the funding of student programming, support services, and staffing, including intervention programs that increase the enrollment and success of underrepresented students in STEM. This is especially true for sustaining funding of intervention programs that serve underrepresented students (Heller 2002), which are often 'add-ons' to institutional programming/support-service efforts. Thus, students who would benefit most from these programs are negatively impacted, threatening their entrance into and/or persistence in STEM majors.

Factors that contribute to an increase in STEM involvement and persistence to degree completion for underrepresented populations must be further examined. STEM intervention programs (SIPs) are one avenue that can facilitate the access and success of women, minorities, low-income, and first-generation students in these fields (DePass and Chubin 2008). In response to the appeals by the education and business communities mentioned above, and by the US Department of Commerce (2011), this study investigates how the structure and support of SIPs reflect a university's commitment to diversify STEM, and the long-term sustainability of programs that impact the recruitment and retention of underrepresented students in these fields.

STEM intervention programs (SIPs)

A STEM education program, as defined by the United States Government Accountability Office (GAO), may include one or more of the following objectives: (1) attract or

prepare students to pursue classes or coursework; (2) attract students to pursue STEM degrees; (3) provide undergraduate or graduate training in STEM; (4) attract graduates to pursue STEM careers; and (5) increase the ability of K-12 or postsecondary institutions to promote education in STEM fields (Scott 2013). The SIPs included in this study attempt to increase access and persistence of underrepresented students in STEM through the following strategies: pre-college interventions, supplemental education programs, academic bridge programs, living-learning communities, research programs, mentorship interventions, and hybrids of multiple intervention components. Historically, SIPs were established to increase access to STEM fields and improve the educational experiences of students inadequately represented within STEM fields, including women, students of color, first-generation, and low-income students (DePass and Chubin 2008). Despite the inability to assess effectiveness of STEM education programs, new SIPs continue to be created (Scott 2013).

Ideally, SIPS are tailored to meet the specific needs of their targeted recipients, resulting in a wide variety of program designs, purposes, and services. The location of intervention within the university, the organizational structure, recipients, services, and funding sources of such programs vary greatly. Some SIPs are unique to a specific department, college, or university, while others are funded by agencies such as the National Science Foundation, and are found at many universities. In an assessment of over 200 federally funded programs, the GAO found that a majority of SIPs at the postsecondary level targeted engineering, biology, technology, chemistry, and computer science fields (Scott 2013).

In response to the many calls for diversifying the STEM fields and strengthening the United States' STEM workforce, research regarding the funding practices and sustainability of SIPs is needed, particularly as these programs impact students' decisions to enter and remain in these fields.

Legitimacy

The theoretical framework used to explore institutional funding of SIPs is the theory of legitimacy. Drawing on organizational, institutional, and resource dependency theories, legitimacy is defined as the process by which an organization and its services are valued by society and stakeholders (Deegan 2000; Wilcox 2007). The institutionalization process often occurs by incorporating mainstream norms and values found in society (Meyer and Rowan 1977; O'Donovan 2002). The process of legitimation may occur in several distinct steps, including initial innovation and validation of the entity of interest (Johnson, Dowd, and Ridgeway 2006), rather than a one-time event. Oftentimes, organizations are influenced by external sources to incorporate or adopt legitimated elements as a means for increasing the probability of survival (Zucker 1987). Gaining legitimacy is important for long-term survival of the entity, and as an organization becomes legitimate, the organization sustains resources from the environment (Hannan and Freeman 1989; Zucker 1987).

Programs in higher education oriented toward assisting a targeted group of students may be viewed externally as 'add-on' services. As such, the ability of a student service program or office to establish and maintain legitimacy becomes important in their long-term sustainability and viability on campus. SIPs' long-term existence depends on institutionalization of practices and sustainability of the services provided (Bailey et al. 2004). Without also establishing or gaining legitimacy, the program may struggle to receive recurring funding, secure support from upper-level administrators, and negotiate its position within the larger university.

Specific to SIPs, programs seeking legitimacy may incorporate structures and procedures that match norms and practices found within a college or university. As a result, SIPs may align their missions and goals with organizational values to gain legitimacy and secure additional resources. This has been observed in many SIPs that shifted their programmatic mission from providing opportunities to underrepresented students in STEM to include the recruitment of underrepresented graduate students in STEM on behalf of the institution (Walker et al. 2010). The latter goal fulfills the organization or university's goal of increasing the number of (underrepresented) graduate students in STEM fields, rather than providing an enrichment program for students.

By contributing to the organization's needs, SIPs are viewed as legitimate programs, and receive resources to fulfill their (new) mission and goals. Therefore, the connection between the organization and the program becomes inextricably linked through the process of legitimation and allocation of resources. With additional resources, SIPs further provide services to students, hire staff, and meet the organizational goals of the institution. Once legitimacy is established, the link between resources, funding, staffing, and legitimacy becomes cyclical (George-Jackson and Rincon 2012). If the organization or other external stakeholders do not view the program as legitimate, securing resources over a sustained period of time becomes difficult for the SIP, threatening its long-term existence and ability to serve students.

Data and methodology

The current study is part of a larger study on underrepresented undergraduate students in STEM at large, public research-intensive universities, funded by the National Science Foundation. The study focuses on student and institutional factors that impact the educational outcomes of undergraduate students, including the enrollment, persistence, and degree attainment of women, racial and ethnic minorities, and low-income students in the STEM fields. The overall study draws on quantitative and qualitative data to further understandings of undergraduate students in the sciences.

The study presented here utilizes qualitative data from 2009 and 2010. This particular component of the project examined the design, structure, implementation, and challenges of SIPs from the perspectives of program directors and administrators. The interviews conducted in this study were semi-structured, and as a result, not every participant received the same questions. Participants were purposefully selected by searching each university's website for SIPs targeting underrepresented undergraduate students, including women, students of color, first-generation students, and low-income students.

While the specific missions, goals, services, and targeted populations of each program included in the study varies (see Table 1), each aims to increase the enrollment, persistence, and/or graduation rates of underrepresented students in STEM. Examples of SIPs in the study include, but are not limited to the following: research programs, mentoring and tutoring programs, leadership development programs, living-learning communities, and first-year experiences for underrepresented students in STEM (e.g. designated housing and first-year seminars) (see Table 2). Mentoring and networking is the most common service provide by SIPs. Just over half of SIPs include academic advising, professional development, exposure to STEM, and residential experiences. Table 2 also shows how many SIPs provide a combination of the services mentioned above. These services may overlap with services provided by other SIPs at the same institution. The Government Accountability Office also found

	n	%
Female only	11	23
Racial minorities only	19	40
Underrepresented students broadly	16	33
Other	2	4

Other category includes programs aimed at specific majors and class standing.

Table 2. Services provided by SIPs (N = 48).

	n	%
Academic advising	29	60
Financial support	16	33
Professional development	25	52
Exposure to STEM	26	54
Social interaction	10	21
Structured learning and tutoring	15	31
Hands on experience and research	22	46
Residential experiences	25	52
Recruitment	3	6
Mentoring and networking	41	85

Percentages represent multiple services provided by a single SIP. Residential experiences include summer programs and living and learning communities.

similar overlap among federally funded SIPs, however overlap did not mean there was a duplication of services given that SIPs generally target different populations (e.g. women, racial minorities, or specialized fields) (Scott 2013).

Participants included SIP program directors and administrators. A total of 137 individuals from nine universities were invited to participate in the study, of which 55 SIP administrators agreed to participate, representing 48 unique SIPs. Their demographic information and educational backgrounds appear in Table 3. The majority of SIP administrators in the study were female and just over half were white. Approximately half of the participants had been in their current position for less than five years, averaging six years across all respondents. The majority of SIP administrators had more than a bachelor's degree and just under half have received or were in the process of receiving their doctoral degree.

The programs included in this study were established as early as the 1960s and as recently as 2009, and just under half were established in the 1980s and 1990s. About 40% of SIPs targeting women were established in the 1990s and just under half of SIPs targeting racial minorities and underrepresented students broadly were established since 2000.

A total of 14 program administrators – representing 14 SIPs – reported that their program had changed its mission or goals (see Table 4). Administrators cited the following reasons: an increased emphasis on retention, a change in leadership, an expansion of their services (nationally or to include other groups), and a change in their strategies to address different leaks along the STEM pipeline.

The services described by SIP administrators have also changed in important ways. In Figure 1 we see how academic advising is a relatively unchanging service. We also

Table 3. Demographic and background of participants (N = 55).

Variables	n	%
Gender		
Male	12	21.8
Female	43	78.2
Race and Ethnicity		
White	26	47.3
Asian American	2	3.6
Latino/a	5	9.1
African American	21	38.2
Native American	1	1.8
Number of Years in Position		
0 to 5 years	30	54.5
5 to 10 years	15	27.3
More than 10 years	7	12.7
Not Reported	3	5.5
Average Number of Years		6
Minimum Number of Years		1
Maximum Number of Years		26
Highest Level of Education		
Bachelor's	3	5.5
Master's	21	38.2
PhD (in progress)	5	36.4
PhD (obtained)	20	9.1
Not Reported	5	9.1

Table 4. Background of STEM interventions (N = 48).

	n	%
Distribution of SIPs Over the Years	S	
Prior to 1979	6	13
1980 to 1989	11	23
1990 to 1999	10	21
Since 2000	16	34
Not Reported	5	10
Change in Mission or Goals		
No	14	29
Yes	17	35
Not Reported	17	35

see an important change in the proportion of SIPs established since 2000 no longer providing structured learning activities (-48%), financial support (-35%), and residential experiences (-40%) as components of their programs. Hands-on learning activities – such as research opportunities – have seen the largest increase (17%).

The interview protocol asked respondents questions pertaining to the history, mission, goals, services, structure, funding, and outcomes of the program they administer or direct. In addition, interviewees were asked about their own professional background and their responsibilities within the SIP. Questions pertaining to the funding practices, the changing of funding over time, and the structural location of the SIPs are of particular interest here. These questions aimed to understand the characteristics

Source		n	%
Internal 75%	Endowment Provost	6	13 6
n = 36	Housing	2	4
	University	10	21
	College/Ďean	30	63
	Department	5	10
External	State	4	8
71%	Grant (including NSF/NIH)	27	56
n = 34	Alumni	4	8
	Corporate	15	31

Table 5. SIP funding sources (N = 48).

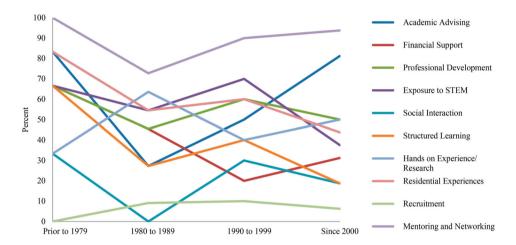


Figure 1. SIP services between 1968 and 2009 (N = 48).

of SIPs that have gained legitimacy at their institutions, specifically through their ability to (1) obtain reoccurring funding; (2) secure upper-level administrative support; and (3) negotiate the program's position within the university setting. Interviewees were asked the following questions about the funding of the SIP(s) for which they held responsibility:

- (1) How is the program funded? Does the source of funding impact delivery? If so, how?
- (2) What is the level of funding from the college, campus, and external sources?
- (3) Can you describe the type and level of support of the program from the college dean? From upper-level administrators? From faculty members?

We utilized an open coding strategy, which allowed us to describe, identify, and categorize the phenomena of interest (Strauss and Corbin 1990). Upon coding, distinct characteristics of institutional programs and common themes and issues across all the

campuses were identified. In order to protect the identity of the study participants, pseudonyms are used with direct quotes.

Results

The analysis revealed three overarching themes related to the funding structures of SIPs: (1) changes in funding over time; (2) diverse sources of funding; and (3) the impact of funding on staffing and service delivery.

Changes in funding over time

The funding sources of several SIPs changed over time, including those at risk for becoming unsustainable after the original grant funding that established the program had expired. Other SIPs were initially supported via 'hard funds' through their university, college, and/or departmental budgets, but are now solely supported by 'soft funds,' relying on grants, corporate donations, and sponsorships. For example, Jennifer describes the shift from 'half hard state money and [half] soft' to '100% soft money.' This trend was found among 16 SIPs in the study that experienced some change in their funding structure over the past five years. Similarly, another program was initially funded by 'seed money' from the president's office, but once that money source was exhausted SIP administrators began supporting intervention efforts through a combination of funds from the diversity office, departmental units, graduate school, and 'add-ons' to existing federal grants from the National Science Foundation (NSF) and the National Institutes of Health (NIH).

As colleges and universities tighten budgets and private sources are affected by the economic crisis, the existence of some SIPs is threatened if alternative sources do not readily exist to replace reduced or diminished funds. As a result, these services may no longer be offered to accommodate reduced expenses or the very existence of some SIPs is at risk. These changes in funding have pressured staff to look for alternative sources of funds. Miguel pointed out that when outside funds are not readily available, 'that's when [SIPs will] know if [upper-level administrators] really support' and value the program.

Diverse sources of funding

Sources and amount of funding strongly influenced the way the intervention program was run, the support of personnel, the resources available, and in some instances the existence of the program. Sources of funding included funds from corporations, colleges and universities.

Corporate funding

Approximately one third of SIPs received some form of corporate sponsorship. For example, the program Erin described 'receives no funding from state money ... all of the funding comes from the industry.' As a result, she described the need to continually seek out additional funding through grant writing. This practice directly impacted the time and resources she could devote to student programming and services. When corporate funding was received, it did not always support the services students needed most. Erin was frustrated when partnering with members from industry who were

not responsive to the unique needs of her students: 'The corporate funding is repetitive and it doesn't depend on the results of the program. We've given them the results and it doesn't matter [if the program doesn't work].' In other cases, corporate sponsorship impacted the structure of the program, as industrial corporations dictated the specific services a SIP provides to students (as a condition of their funding).

A recurring issue expressed by SIPs that depended on corporate funding was the inconsistency in corporate funding. Sonya indicated that receiving funding from corporations helped the program, but that the support was inconsistent: 'When we had a boat load of money, we got a boat load of money. Now that we don't, we don't.' As most grant funding comes with stipulations, programs are often required to spend the grant money by a certain time so they 'spend it fast, without thinking' (Sonya). The changing economy and corporation's own financial health and stability also impacted SIP funding. Daniel described inconsistent funding from corporations:

Historically, the [name redacted] Office has gotten a significant amount of corporate support and still does but it's changed over the years. We used to see money just drop in here ... 'Here, I want to give \$10,000 unrestricted to the [name redacted] Office.' ... First of all, some of the historical supporters run a large auto company. Two of them actually went bankrupt, so those companies don't actually exist now ... so that interrupted some funding.

Although corporate donations make up a large portion of some SIP's budgets, such funds are often inconsistent and unreliable for long-term program delivery and sustainability. Moreover, corporations may benefit more from such donations than the receiving program. Michelle expressed that outside corporations benefitted from having a better selection of students they could hire, specifically diverse teams that will provide innovative talent. These findings suggest the diverse and often complicated roles, as funders and beneficiaries, corporations play as stakeholders within STEM efforts.

Despite the challenges of corporate funding, limited funding elsewhere gives SIPs very few alternatives. In fact, 56% of SIPs in the study relied on grant funding to deliver their program services. As this funding too becomes limited, administrators compete with one another to stay afloat when 'everyone is looking for dollars,' referring to a competitive economic climate (Barbara). Susan describes her frustration with finding alternative funding strategies:

I'm struggling with the idea of trying to get more funding through grants and groups out there, foundations and things – because everyone's trying to get that kind of money and there's not many that are giving directly anymore.

Similarly, Barbara spoke of having a 'long list of companies, local and national organizations that have provided funding' for them in the past. She highlighted the need to be resourceful: 'If there's a dollar under a rock, we're gonna try to find it.' Furthermore, she acknowledged the changing economic climate as directly impacting diversity initiatives:

You know, there was a time where the social imperative was all it took. This was the right thing to support, and how easy was it for – Company X to just cut us a check and say, 'We support diversity initiative.' In this economic climate, the social imperative isn't enough. You gotta pull the business imperative. How does this positively impact your bottom line? And so, because of that, and again, it's been tough economically for everybody. We've seen our corporate dollars go down and our grant dollars go up because we've been in

here writing. We've seen an increase in the amount of funding we've gotten from the college, and that is because of the leadership of our current dean. (Barbara)

College and university funding

Of the 48 programs in the study, 38 received some form of internal support from the college, department, dean, or provost. Programs supported by 'hard funds' often expressed their institution's long-term commitment to their programs and related diversity efforts. Andrea mentioned a campus-wide effort to improve diversity, beginning in the 1980s and continuing today, with funds from the state, university, and individual academic colleges supporting a variety of support-service programs to expand diversity, including SIPs.

These interviewees also spoke of having administrative support and commitment from upper-level administrators on campus. The funding of their programs is seen as a priority and has been sustained over time due to the institution's commitment and funding decisions. Some programs funded through their college and/or university acknowledged the hardships of programs that were on 'soft money.' In response to being asked how their program was funded, Sarah replied: 'Oh, the dean. I mean, 100%. I have a budget. I've had a budget for programming. And I consider myself lucky.' Michael described the support from his dean being crucial to the program's existence:

One of the other things that I shared with the dean is that if it [the program] wasn't going to have money, I wasn't interested because it can't be done. You can't do this stuff for free; you can't even do it with money, so you can't do it for free.

Carlos, who expressed the same type of committed 'hard money' support by the dean and other upper-level administrators, indicated that job security was not an issue that they worried about in comparison to their peer SIPs that relied entirely on soft money. Although Carlos wrote grants to support additional initiatives that would benefit students, he indicated that it was expected that if they had 'an important idea, then the dean should be involved.' Finally, Tina described the source of funding for her program's various components as being embedded in the dean's budget:

The office is funded from the dean's budget. It actually has its own budget. So the dean provides a budget for multicultural programs every year – so, all the programmatic pieces, recruiting and supporting student events come out of that budget. Now scholarships is a separate budget, but it still comes out of the dean's budget.

These interviews emphasize the importance of support from the college dean(s) in funding and implementing the intervention program. Upper-level administrator involvement appears to be directly correlated with the authority and legitimacy of the program in relation to the college or department. Programs which lack access to 'hard funds' that allow for stability of staffing and program services face having the most basic need unmet – staffing.

However, not all deans are as supportive as the ones described above. Robert criticized the dean of his college for giving the same amount of money to the program in the late 1990s as is presently allocated:

I understand that times are hard, but I mean, what does that say? It says you cared more in 1999 than you do – I mean, that's what it says, and you know. That, I didn't say to the dean. But I'll say that to you. It's just— One of my really pet peeves is that we don't

have enough money for this. It's like, that is crap. You guys— This is a \$4 billion enterprise here. You guys got a shitload of money. You don't want to spend your money on us, which is fine. Right? Just say, I don't care that much. The former associate dean, [name redacted], he did say that, and I really admired him for that. I know how much [name redacted] cares. He cares exactly \$100,000.

The dollar amount of support had not changed in over 10 years, even though the dean still supported the idea of the program. To Robert, the percent of money from the dean's budget allocated to the SIP sent a clear message regarding the level of support and importance that the dean gave to the program. Although SIPs may seek out multiple and diverse sources of funding, a lack of adequate funding can negatively impact the program's ability to provide and deliver services to students, as well as staff the program. This is the third, and final, theme found in the data analysis.

Impact on staffing and service delivery

In addition to overall program funding, participants cited 'soft funds' as the biggest impediment to delivering programs and services. Many participants were frustrated with universities, colleges, or departments who opted to have SIP staff supported by soft funds rather than commit budgeted funds to support their salaries. Erin indicated that 'some staff even have to bring in their own salary,' which becomes quite difficult today given economic uncertainty. As SIPs struggle to have access to 'hard funds,' the need to find 'soft funds' increases, directly influencing the priorities of staff who spend an increasing amount of time securing funding and writing proposals for grants.

This pressure on staff to secure funding affects the SIP's service delivery and indirectly impacts the needs of underrepresented students within STEM. Moreover, staffing – central to the mission of providing services to students – was often entirely dependent on the available funds to the SIP:

We used to have a secretary, plus three to five student workers. Now we have three. There used to be more. It all depends on funds. We had a half-time or quarter-time evaluator. There is not one now but I would like us to have one again. (Erin)

Due to issues of being understaffed, many participants indicated that they relied heavily on current students and student organizations for volunteers to aid in program delivery, website management, and marketing. Others shared administrative support staff with other offices in their college. Additionally, although directors and administrators wanted to expand their programs, they indicated that without adequate staffing, such efforts would be highly difficult if not improbable.

Another participant stated that although they did have their salaries paid for by the state and college, the SIP depended solely on external funds to deliver their intervention and 'if [they] don't have funding, [they] can't deliver the programs' (Michelle). The program coordinator expressed how without support from external donations, program tuition, and corporate sponsorships, the undergraduate research program and the freshman camp would cease to exist. Only self-supporting STEM programs would continue. Unlike other programs, the program coordinator felt confident that their SIP was seen as a legitimate investment. Thus, the existence of the SIP benefited the college by recruiting women, providing better educational experiences for female students, and increasing retention within STEM. Indeed, the source of funding for SIPs has a direct impact on the legitimacy of the SIP. The SIP geared towards

women within STEM had access to some 'hard funds' through their respective college, which facilitated access to additional sources of funding.

When universities fail to commit funds to SIPs, the jobs of the administrators and directors, and in some cases the program itself, are at risk. Of the nine universities included, one faced particular hardships with regards to sustainability of their SIPs. Of 10 interviews completed on that campus, representing 10 different SIPs, two directors indicated that their appointments would not be renewed due to budget cuts. In both of these cases, the directors represented the entire staff of those SIPs. These participants expressed concerns about the long-term viability of their programs given that the only staff member was leaving. Without institutional commitment to the program, the services it delivers, and to the staff that runs these programs, many SIPs are at risk in terms of longevity and sustainability. As one participant described, her responsibility to secure funding detracted her from delivering services to students:

I really need to shift my focus, too, on securing the funding that we need to run the program the way we'd like to run it. I'm exhausted worrying about can we afford to do it? I hate that issue. (Barbara)

From the interviews, it is clear that overall funding, sources of funding, and (lack of) institutional investment in SIPs impact their delivery and sustainability, as well as reflect upon the university's commitment to diversifying STEM via intervention programs.

Limitations

Given that the data draws on SIPs located at large, public, four-year, research-intensive, and predominantly white universities, generalizability of the results to non-peer institutions is somewhat limited. The interventions in this study are also restricted to programs found at institutions in the United States and it is unknown if SIPs like those featured in this study have been replicated to non-US settings. In addition, the recruitment of potential interview participants was based on a search of publicly available information on each university's website. As a result, if a SIP was not listed online, or was not located by the research team, the program's administrators were not invited to participate in the study.

An effort was made to include interventions from a broad set of science- and mathematics-based fields. However, the majority of intervention programs were housed in engineering and computer sciences. Where programs in the study are housed in terms of the disciplinary affiliations or controlling colleges and departments limits the generalizability to student services found in other departments and colleges. The views expressed within the study are solely opinions and observations of the program directors and administrations who self-selected to participate in the study, and do not necessarily reflect the opinions and experiences of students impacted by the programs, thus presenting an opportunity for future inquiry. Furthermore, the comments and opinions of SIP administrators and directors are limited to those who were interviewed in the study.

Discussion and conclusion

As universities make difficult budget decisions regarding the level of funding (if any) to SIPs, their actions signal the extent to which SIPs are viewed as legitimate entities

within a given department, college, or institution. Programs that struggle to gain financial or other forms of support from upper-level administrators are viewed as illegitimate and not valued by important university stakeholders. In these situations, SIPs are seen as add-ons or unnecessary supplemental programs. The organizational structure and position of a SIP within the institution may influence the SIP's legitimacy.

SIPs desire to be viewed and perceived as legitimate entities, which aids in their long-term institutionalization and sustainability (Bailey et al. 2004). Legitimacy validates the purpose of SIPs as necessary entities within the university, and directly affects the long-term stability and financial support SIPs receive from their college, departments, and the university. The findings from this study support that as SIPs become legitimate structures within their college and within their departments, they become a priority for funding through 'hard funds.' This additional sustainability permits SIPs to have access to adequate staffing, resources, and visibility to successfully serve students. As public universities make difficult budget decisions, the decision to fund, decrease the amount of funding, or discontinue the funding of SIPs becomes one indicator of the institution's commitment to supporting SIPs and to diversifying STEM fields. High levels of institutional commitment to diversity would support the retention of student populations that have been traditionally underserved within higher education, specifically in STEM, by funding the SIPs that serve them.

Findings reveal that institutional funding priorities for intervention programs often do not correlate with the nation's need to increase the number of STEM degrees awarded to domestic students, particularly to underrepresented students. As institutions pay lip service to diversity initiatives, upper-administrators' levels of support and funding practices of SIPs send a different message. While decisions related to SIPs do not occur in isolation, decisions to support SIPs by higher education leaders occur alongside the need for effectiveness across a variety of colleges, departments, and programs (Bryman 2007). Programs that have been historically created to address a dire need are left scrambling to stay afloat. As large, public, research universities fail to expand access to traditionally underserved populations within STEM, the message that equity and diversity is important is called into question. This study argues that SIPs seek legitimacy from their departments, college, and institutions in order to secure the financial sustainability of their programs that enable large, public, research universities to not only expand access, but also contribute to the number of students pursuing a career within the STEM workforce.

Recommendations

Policy implications include providing incentives to corporations and private funders that invest in diversifying STEM higher education and the workforce. SIP–industry partnerships should be established with corporations who seek to diversify their workforce. Industry partners can also provide SIPs with internship opportunities that serve as a recruitment tool for future employees.

SIP programs may also offer administrative internships to address inadequate staffing to continue delivering the same resources with limited funding. Access to interns, such as those from education, evaluation, and higher education administration, would allow for successful SIPs to provide their services with proper staffing and prepare future generations of SIP administrators. Moreover, the evaluations conducted can improve the services provided, provide data to secure outside funding, and increase the legitimacy of their entity by providing evidence of the impact of SIPs (George-Jackson and Rincon

2012). In addition to internships, partnerships with STEM-themed student organizations may allow SIP program administrators and coordinators to have access to underrepresented students in STEM who may serve as role models and student academic mentors without additional financial constraints. However, administrators are cautioned that reliance on undergraduate students should be monitored as to not distract students from their own success in college.

Through evaluations, SIPs have access to data that can improve the services they provide and their impact on students, but might also establish their legitimacy as stakeholders within a college or department. This strategy allows SIPs to gain legitimacy through authority, where SIPs not only gain authority as legitimate stakeholders, but have evidence to provide to upper-level administrators that their program is beneficial. In a time when higher education leaders are adopting more business-like strategies to effectively manage and advance their institutions (Davies, Hides, and Casey 2001), directly communicating the effectiveness of a program and explicitly including a cost-benefit analysis may aid in arguing for support.

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Note

1. The terms persistence and retention are used interchangeably throughout the article.

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